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Interventions and Management

1. *Acta Paediatr.* 2016 Feb 16. doi: 10.1111/apa.13368. [Epub ahead of print]

Pain in Children and Adolescents with Cerebral Palsy A Population Based Registry Study.

Alriksson-Schmidt A, Hägglund G.

AIM: We assessed prevalence and location of pain in a total population of children and adolescents with cerebral palsy (CP) based on the Gross Motor Function Classification System (GMFCS), age and gender. **METHODS:** This cross-sectional study was based on the last assessment of children aged 1-14 years in the combined Swedish follow-up programme and national quality register programme for CP. All were born 2001-2012 and reported to the registry in 2013-2014. Logistic regression was used to regress age, gender and the GMFCS level on the presence of pain. We also assessed pain sites among GMFCS groups. **RESULTS:** We included 2,777 children (57% boys) at a median age of seven years; 32.4% reported pain, with significantly more girls than boys experiencing pain and significantly more children at GMFCS levels III and V than GMFCS I. Pain frequency increased with age and differences among GMFCS levels were found in the lower extremities and abdomen. Pain in the abdomen and hips was most frequent at GMFCS V, knee pain at level III and foot pain at level I. **CONCLUSION:** Our results showed that although a lower prevalence than in many other studies, pain constituted a significant problem in children and adolescents with CP. This article is protected by copyright. All rights reserved.

[PMID: 26880375](#)

2. *Dev Med Child Neurol.* 2015 Nov 24. doi: 10.1111/dmcn.12966. [Epub ahead of print]

Efficacy of three therapy approaches in preschool children with cerebral palsy: a randomized controlled trial.

Kruijssen-Terpstra AJ, Ketelaar M, Verschuren O, Gorter JW, Vos RC, Verheijden J, Jongmans MJ, Visser-Meily A.

AIM: To examine the efficacy of child-focused, context-focused, and regular care approaches, delivered in a rehabilitation setting by physical or occupational therapists to preschool children with cerebral palsy (CP), in optimizing the child's self-care and mobility capabilities. **METHOD:** A multicentre randomized controlled trial clustered at therapist level was conducted in 13 rehabilitation centres. It included 68 children with CP (38 males, 30 females; mean age 3y, SD 6mo, range 1y 11mo-4y), classified as Gross Motor Function Classification System levels I to IV, who were already receiving therapy. Children received a child-focused, context-focused, or regular care approach during a 6-month period. Self-care and mobility capabilities were assessed with the Functional Skills Scale of the Pediatric Evaluation of Disability Inventory. **RESULTS:** The child-focused, context-focused, and regular care approaches all resulted in significant but similar improvements in self-care (regular: reference; child-focused: $\beta=-0.11$, 95% confidence interval [CI] -0.68 to 0.46; context-focused: $\beta=0.13$, CI -0.38 to 0.64) and mobility (regular: reference; child-focused: $\beta=-0.09$, CI=-0.93 to 0.75; and context-focused: $\beta=0.14$, CI -0.65 to 0.94) capabilities.

INTERPRETATION: The results suggest that the three therapy approaches were equally efficacious for preschool children with CP. Depending on a child's individual situation each approach can be selected.

[PMID: 26880083](#)

3. Dev Neurorehabil. 2016 Feb 18:1-5. [Epub ahead of print]

Sonographic and clinical effects of botulinum toxin Type A combined with extracorporeal shock wave therapy on spastic muscles of children with cerebral palsy.

Picelli A, Marchina E, Gajofatto F, Pontillo A, Vangelista A, Filippini R, Baricich A, Cisari C, Smania N.

OBJECTIVE: The aim of this study was to compare the combined sonographic and clinical effects of botulinum toxin type A (BoNT-A) and extracorporeal shock wave therapy (ESWT) versus BoNT-A alone in children with cerebral palsy. METHODS: Ten children with spastic cerebral palsy were randomly assigned to one of two groups. Group 1 received BoNT-A injection into the spastic muscles of the affected limbs plus three ESWT sessions. Group 2 received BoNT-A alone. Assessment was performed before and 1 month after injection. Sonographic outcomes were injected muscles echo intensity and their hardness percentage, and clinical outcomes the modified Ashworth scale and the Tardieu scale. RESULTS: At 1-month evaluation, significant differences in the injected muscles percentage of hardness ($P = 0.021$) and the modified Ashworth scale ($P = 0.001$) were found between groups. CONCLUSIONS: Our results support the hypothesis that the combined effects of BoNT-A and ESWT derive from their respective action on neurological and non-neural rheological components in spastic muscles.

[PMID: 26890193](#)

4. Dev Neurorehabil. 2016 Feb 18:1-6. [Epub ahead of print]

Short-term balance training with computer-based feedback in children with cerebral palsy: A feasibility and pilot randomized trial.

Saxena S, Rao BK, Senthil KD.

OBJECTIVE: To assess the feasibility of using short-term balance training with computer-based visual feedback (BTVF) and its effect on standing balance in children with bilateral spastic cerebral palsy (BSCP). METHODS: Out of the fourteen children with BSCP (mean age = 10.31 years), seven children received four sessions of BTVF (two such sessions/day, each session = 15 min) in comparison to the control group that received standard care. Feasibility was measured as percentages of recruitment, retention and safety and balance was measured using a posturography machine as sway velocity (m/s) and velocity moment (m/s²) during quiet standing. RESULTS: No serious adverse events occurred in either group. There were no differences in the retention percentages and in any clinical outcome measure between both groups. CONCLUSION: Use of BTVF is feasible in children with BSCP but further investigation is required to estimate a dose-effect relationship.

[PMID: 26889691](#)

5. Disabil Rehabil. 2016 Feb 15:1-14. [Epub ahead of print]

Determinants of participation in family and recreational activities of young children with cerebral palsy.

Chiarello LA, Bartlett DJ, Palisano RJ, McCoy SW, Fiss AL, Jeffries L, Wilk P.

Purpose To test a model of child, family and service determinants of participation in family and recreational activities for young children with cerebral palsy (CP). Methods Participants were a convenience sample of 429 children (242 males) with CP, aged 18 to 60 months, representing all levels of the Gross Motor Function Classification System (GMFCS). Children were divided into two groups by GMFCS levels, levels I to II and levels III to V. Data on impairments and gross motor function were collected by therapists; parents provided information about children's health conditions and adaptive behaviour. Seven months later, parents reported on family life and services received. One year after the beginning of the study, parents reported their children's participation. Data from the two groups of children were analysed separately using structural equation modelling. Results The model explained 35% and 40% of the variance of frequency of participation in family and recreation and 28% and 38% of enjoyment in participation, for the two groups of children, respectively. Children's adaptive behaviour, family ecology, and number of community recreational programs were associated with the frequency of participation for both

groups. Gross motor function was only associated with the frequency of participation for children in levels III-V. Adaptive behaviour was associated with enjoyment for both groups. The extent services met children's needs was associated with enjoyment for children in levels I to II and family ecology was a determinant of enjoyment for children in levels III to V. Conclusion Supporting children's adaptive behaviour, family ecology, and access to community recreational programmes may foster participation in family and recreational activities for young children with CP. Implications for Rehabilitation Participation in family and recreational activities for young children with CP is complex and influenced by child, family and environmental factors. Practitioners are encouraged to support children's adaptive behaviour and access to community programs and family relationships, involvement in community activities and expectations of their children. Optimizing gross motor function for children who have limitations in self-mobility may enhance their participation in family and recreational activities. For children with a good prognosis for walking, providing services perceived by parents to meet their children's needs may enhance children's enjoyment of participation.

[PMID: 26878416](#)

6. Iran J Psychiatry. 2015 Apr;10(2):86-92.

Efficacy of Mindfulness-Based Cognitive Therapy on Quality of Life of Mothers of Children with Cerebral Palsy.

Sedaghati Barog Z, Younesi SJ, Sedaghati AH, Sedaghati Z.

OBJECTIVE: The findings demonstrated that parents of children with cerebral palsy experience elevated levels of distress, depression, anxiety, posttraumatic stress symptom and subjective symptom of stress and low quality of life. Effective interventions targeting relapse have the potential to dramatically reduce the point prevalence of this condition. Many studies have shown that Mindfulness Based Cognitive Therapy (MBCT) is an intervention that has shown efficacy in improving quality of life. In this study, the effect of Mindfulness -Based Cognitive Therapy (MBCT) on increasing quality of life in mothers of children with cerebral palsy has been examined. **METHOD:** Three mothers of CP children with low scores on quality of life in WHOQOL-BREF inventory participated in this single- case study. **RESULTS:** Findings revealed that the MBCT program elevated quality of life of the participants. The improvement quotient for quality of life of each participant was good. **CONCLUSION:** The results have implication for efficacy of mindfulness for improvement of psychosocial life of families of children with cerebral palsy.

[PMID: 26884784](#)

7. J Biomed Opt. 2016 Feb 1;21(2):28001. doi: 10.1117/1.JBO.21.2.028001.

Evaluation of low-level laser therapy in the treatment of masticatory muscles spasticity in children with cerebral palsy.

Santos MT, Diniz MB, Gouw-Soares SC, Lopes-Martins RA, Frigo L, Baeder FM.

Abstract. Spasticity is a motor disorder frequently present in individuals with cerebral palsy (CP). This study aimed to evaluate the effect of low-level laser therapy (LLLT) on the spasticity of the masseter and anterior temporal muscle fibers in children with CP over three weeks of intermittent laser exposures. The bite force (BF) of the masticatory muscles and the amplitude of mouth opening were evaluated before and after laser irradiation in 30 children with CP. Both sides of the masseter and temporalis muscles were irradiated with low-intensity diode laser pulses of 808-nm wavelength six times over three consecutive weeks. During the subsequent three weeks of postlaser exposures, although no laser treatment was applied, the evaluation parameters were measured and recorded. A significant improvement in the amplitude of mouth opening and a decrease in the BF were observed in the weeks following LLLT ($P < 0.05$). However, by the sixth week post-LLLT, the BF and the amplitude of mouth opening reverted to values equivalent to those obtained before the first application of LLLT. Our investigation revealed low-level energy exposures from a 808-nm diode laser to be an effective short-term therapeutic tool. This method increased the amplitude of mouth opening and decreased the muscle tonus of children with spastic CP over a time course of three weeks of intermittent laser applications.

[PMID: 26882450](#)

8. J Pediatr Orthop B. 2016 Feb 18. [Epub ahead of print]**Hip pain is more frequent in severe hip displacement: a population-based study of 77 children with cerebral palsy.**

Ramstad K, Terjesen T.

The aim of this study was to assess whether hip pain was associated with radiographic hip displacement (migration percentage, MP) in a population-based cohort of children with cerebral palsy. Seventy-seven children, mean age 9.5 (SD 1.6) years and Gross Motor Function Classification System level III-V, were assessed. Caregivers responded to the Child Health Questionnaire pain questions and located recurrent pain on a body map. Hip pain was reported in 22 children (29%) and 27 hips (18%). Hip pain was significantly more frequent in hips with MP more than or equal to 50%, in children with spastic quadriplegia, and in those with Gross Motor Function Classification System level V. We conclude that severe hip displacement with MP more than or equal to 50% was associated with hip pain, whereas slight or moderate subluxation did not influence the occurrence of such pain.

[PMID: 26895291](#)

9. J Strength Cond Res. 2016 Feb 12. [Epub ahead of print]**Explosive resistance training increases rate of force development in ankle dorsiflexors and gait function in adults with cerebral palsy.**

Kirk H, Geertsen SS, Lorentzen J, Krarup KB, Bandholm T, Nielsen JB.

Alterations in passive elastic properties of muscles and reduced ability to quickly generate muscle force contribute to impaired gait function in adults with cerebral palsy (CP). Here, we investigated if 12 weeks of progressive and explosive resistance training (PRT) increases rate of force development of ankle dorsiflexors (RFDdf), improves gait function and affects passive ankle joint stiffness in adults with CP. Thirty-five adults (age 36.5; range: 18-59 years) with CP were non-randomly assigned to a PRT or non-training control (CON) group in this explorative trial. The PRT group trained ankle dorsiflexion, plantarflexion, leg press, hamstring curls, abdominal curls and back extension 3 days/week for 12 weeks, with 3 sets per exercise and progressing during the training period from 12-6 RM. RFDdf, 3-D gait analysis, functional performance and ankle joint passive - and reflex-mediated muscle stiffness were evaluated pre and post. RFDdf increased significantly following PRT compared to CON. PRT also caused a significant increase in toe lift late in swing and a significantly more dorsiflexed ankle joint at ground contact and during stance. The increased toe lift amplitude was correlated to the increased RFDdf ($r=0.73$). No other between-group differences were observed. These findings suggest that explosive PRT may increase RFDdf and facilitate larger range of movement in the ankle joint during gait. Explosive PRT should be tested in clinical practice as part of a long-term training program for adults with CP.

[PMID: 26890969](#)

10. Lung. 2016 Feb 16. [Epub ahead of print]**Association Between Chronic Aspiration and Chronic Airway Infection with Pseudomonas aeruginosa and Other Gram-Negative Bacteria in Children with Cerebral Palsy.**

Gerdung CA, Tsang A, Yasseen AS, Armstrong K, McMillan HJ, Kovesi T.

PURPOSE: Children with cerebral palsy (CP) are at an increased risk for aspiration, and subsequent pneumonia or pneumonitis. Pneumonia is a common cause of hospital admission, intensive care unit (ICU) admission, and death in patients with CP, and may disproportionately contribute to mortality. The role of respiratory microflora is unknown. This study examined the relationship between respiratory infections with Gram-negative bacteria (GNB), particularly *Pseudomonas aeruginosa*, and the frequency/severity of pneumonia hospitalization. **METHODS:** Retrospective chart review of 69 patients with CP and hospitalization for pneumonia. Eligible patients required hospitalization for bacterial pneumonia, at least one respiratory culture, and fulfillment of Bax definition of CP. Group assignment was based on respiratory culture. Charts were analyzed for comorbid illness, hospitalization demographics, and disease severity. **RESULTS:** Children with isolation of *P. aeruginosa* or other GNB had increased frequency of ICU admission (77.4, 65.1, vs. 26.9 %, respectively, $p < 0.01$), intubation (45.2, 39.5 vs. 11.5 %, $p = 0.02$, $p = 0.03$ respectively), and large pleural effusions (37.5, vs. 0 %) than children without GNB. Children with isolation of GNB had more prolonged hospitalizations and were more likely to have multiple hospitalizations than those without GNB. **CONCLUSION:** Colonization with *P. aeruginosa* and other Gram-negative organisms in children

with CP is associated with increased morbidity, prolonged hospitalization, and severity of pneumonia including need for PICU admission and intervention. Further research is required to determine causality, the role of antimicrobials active against Gram negative in pneumonia treatment, and the role of GNB eradication therapy in children with CP.

[PMID: 26883134](#)

11. Neuropediatrics. 2016 Feb 15. [Epub ahead of print]

Health-Related Quality of Life in Children and Adolescents with Cerebral Palsy: A Secondary Analysis of the DISABKIDS Questionnaire in the Field-Study Cerebral Palsy Subgroup.

Mueller-Godeffroy E, Thyen U, Bullinger M.

Introduction Health-related quality of life (HRQOL) instruments are increasingly being used to evaluate interventions and therapy outcomes in children and adolescents with cerebral palsy (CP). A variety of psychometrically sound and validated generic and disease-specific instruments are available. A third type of instrument, the chronic-generic instrument, pertains to features of HRQOL that are shared by various chronic conditions. The DISABKIDS family of questionnaires consists of a chronic-generic core measure (DCGM-37) and several condition-specific modules, among these, a CP module (CPM). The objective of this article was to describe the performance and, specifically, the validity of the DCGM-37 and CPM in children and adolescents with CP. **Methods** Psychometric properties of the DCGM-37 and the CPM are presented. The discriminant validity was assessed compared with generic measures of HRQOL regarding different levels of impairment (physical independence; developmental delay). **Results** A total of 86 patients with CP (mean age 13 years, range 7-19 years) and 78 main caretakers participated in this study. The DCGM-37 and CPM showed much better discriminative ability as compared with generic questionnaires. **Conclusions** The DCGM-37 and CPM were able to differentiate between patients with different levels of impairment and can be recommended for treatment evaluation and group comparison in clinical studies of children and adolescents with CP.

[PMID: 26878168](#)

12. Neurourol Urodyn. 2016 Feb 19. doi: 10.1002/nau.22982. [Epub ahead of print]

Lower urinary tract symptoms and urodynamic findings in children and adults with cerebral palsy: A systematic review.

Samijn B, Van Laecke E, Renson C, Hoebeke P, Plasschaert F, Vande Walle J, Van den Broeck C.

AIMS: To systematically review the scientific literature addressing lower urinary tract symptoms (LUTS) and urodynamic findings in adults and children with Cerebral Palsy (CP). Prognostic factors were also investigated. **METHODS:** A systematic research was conducted on the electronic databases PubMed, Web of Science, and CINAHL. Only full text clinical trials which examined the prevalence of LUTS or urodynamic findings in children or adults with CP were eligible. LUTS and urodynamic findings, defined by the International Children's Continence Society, were extracted from the included studies. Pooled average of extracted data was calculated. Studies were scored on methodological and reporting quality using the Dutch Cochrane Checklist, EBRO guidelines, and the Strengthening the Reporting of Observational Studies in Epidemiology Statement (STROBE) checklist. **RESULTS:** Twenty-seven studies fulfilled selection criteria. Methodological and reporting quality were moderate to low. An average of 55.5% of subjects with CP experience one or more LUTS. Storage symptoms are more common than voiding symptoms due to the high prevalence of neurogenic detrusor overactivity. Patients with voiding symptoms and pelvic floor overactivity are more prone to progress to upper urinary tract dysfunction in adult life. Urodynamic evaluation can direct management. Negative prognostic factors are the spastic subtype with quadriplegic distribution, moderate to severe functional impairment (GMFCS III or higher) and severe cognitive impairment. **CONCLUSION:** The significant prevalence of LUTS, risk for deterioration, and the impact of urinary tract symptoms on quality of life and health status warrants the need for evaluation and treatment in further research.

[PMID: 26894322](#)

13. Phys Occup Ther Pediatr. 2016 Feb 18:1-13. [Epub ahead of print]**Validity and Responsiveness of the Trunk Impairment Scale and Trunk Control Measurement Scale in Young Individuals with Cerebral Palsy.**

Pham HP, Eidem A, Hansen G, Nyquist A, Vik T, Sæther R.

AIM: This study examines construct validity and responsiveness of the Trunk Impairment Scale (TIS) and Trunk Control Measurement Scale (TCMS) in individuals with cerebral palsy (CP). **METHODS:** Twenty-six individuals with CP (nine males), 8-29 years (mean age 17.6) with gross motor function corresponding to GMFCS I-IV, participated in three weeks of intensive and varied physical training at a health sports center. Trunk control was assessed with the TIS (includes three subscales) and TCMS (includes three subscales), and gross motor function with the Gross Motor Function Measure 66 item set (GMFM-66-IS), before and after the training period. The GMFM-66-IS was used as a comparison measure. **RESULTS:** The median score of the TCMS subscale dynamic sitting balance, reaching (DSB-R), increased from 6 to 7 (range: 1-10; $p = .031$), and there was a median change of 3 points in GMFM-66-IS score ($p = .036$). There were no significant changes in the TIS. The correlations (Spearman's rho), between the TIS, TCMS, and the GMFM-66-IS (pre-scores), ranged between 0.57 and 0.75 ($p < .003$). Correlations between change scores (pre- and post-scores) were low, and not statistically significant. However, the TCMS DSB-R change score correlated significantly with hours spent on "trunk-targeted training" like paddling/rowing ($\rho = 0.66$; $p = .003$) and horseback riding ($\rho = 0.54$; $p = .011$). **CONCLUSIONS:** Our results support construct validity of the TIS and TCMS in young individuals with CP, whereas responsiveness could not be documented. However, the correlations between the TCMS DSB-R change score and hours spent on "trunk-targeted training" suggest that this subscale may have the potential to be used in intervention studies.

[PMID: 26890372](#)

14. Phys Ther. 2016 Feb 18. [Epub ahead of print]**Obstacle Crossing During Gait in Children With Cerebral Palsy: A Cross-Sectional Study With Kinematic Analysis of Dynamic Balance and Trunk Control.**

Malone A, Kiernan D, French H, Saunders V, O'Brien T.

BACKGROUND: Balance problems are common in active, ambulant children with Cerebral Palsy (CP). Control of the whole-body centre of mass (CoM) is critical in maintaining dynamic stability during challenging mobility tasks, such as clearing an obstacle while walking. **OBJECTIVE:** To measure trunk and lower limb kinematics and CoM control in children with CP compared to typically-developing (TD) children during obstacle crossing. **DESIGN:** A cross-sectional study. Thirty-four children aged 5-17 years, 17 with CP and 17 TD, matched for age and height, completed two gait trials crossing a 10cm obstacle. **METHODS:** Three-dimensional kinematic and kinetic data were captured using a Codamotion system and Kistler force plates. Trunk data were captured using a validated model. **RESULTS:** All children cleared the obstacle with similar hip and knee kinematics, step length and single support duration. Step width was 4.81cm higher in children with CP ($p=0.03$). CoM velocity was significantly slower at lead limb toe-off (0.31m/s, $p<0.01$) and during lead limb clearance (0.2m/s, $p=0.02$). Children with CP showed altered trunk and pelvis movement, characterised by significantly greater pelvic obliquity, pelvic tilt, and trunk rotation throughout the task, increased lateral trunk lean during lead limb crossing (3.7°, $p=0.05$), and greater sagittal trunk movement as the trail limb crossed (5.1°, $p=0.01$). **LIMITATIONS:** The study was not powered to analyse differences between children with diplegia and hemiplegia. **CONCLUSIONS:** Children with CP required greater adjustments at the trunk and pelvis to achieve successful obstacle crossing. The increase in trunk movement could be compensatory for reduced stability distally, or a primary problem reflecting poor proximal control. The findings suggest that rehabilitation should focus both on proximal trunk control and distal stability to improve balance.

[PMID: 26893506](#)

Prevention and Cure

15. *Neural Regen Res.* 2015 Dec;10(12):2018-24. doi: 10.4103/1673-5374.172321.

Mononuclear cells from the cord blood and granulocyte colony stimulating factor-mobilized peripheral blood: is there a potential for treatment of cerebral palsy?

Koh H, Hwang K, Lim HY, Kim YJ, Lee YH.

To investigate a possible therapeutic mechanism of cell therapy in the field of cerebral palsy using granulocyte-colony stimulating factor (G-CSF)-mobilized peripheral blood mononuclear cells (mPBMCs), we compared the expression of inflammatory cytokines and neurotrophic factors in PBMCs and mPBMCs from children with cerebral palsy to those from healthy adult donors and to cord blood mononuclear cells donated from healthy newborns. No significant differences in expression of neurotrophic factors were found between PBMCs and mPBMCs. However, in cerebral palsy children, the expression of interleukin-6 was significantly increased in mPBMCs as compared to PBMCs, and the expression of interleukin-3 was significantly decreased in mPBMCs as compared to PBMCs. In healthy adults, the expression levels of both interleukin-1 β and interleukin-6 were significantly increased in mPBMCs as compared to PBMCs. The expression of brain-derived neurotrophic factors in mPBMC from cerebral palsy children was significantly higher than that in the cord blood or mPBMCs from healthy adults. The expression of G-CSF in mPBMCs from cerebral palsy children was comparable to that in the cord blood but significantly higher than that in mPBMCs from healthy adults. Lower expression of pro-inflammatory cytokines (interleukin-1 β , interleukin-3, and -6) and higher expression of anti-inflammatory cytokines (interleukin-8 and interleukin-9) were observed from the cord blood and mPBMCs from cerebral palsy children rather than from healthy adults. These findings indicate that mPBMCs from cerebral palsy and cord blood mononuclear cells from healthy newborns have the potential to become seed cells for treatment of cerebral palsy.

[PMID: 26889193](#)